DOCUMENT RESUME

ED 288 796 SO 018 590

AUTHOR Crews, Kimberly A.
TITLE Human Needs and Nature's Balance: Population, Resources, and the Environment. A Population Learning Series.
INSTITUTION Population Reference Bureau, Inc., Washington, D.C.
PUB DATE Oct 87
NOTE 17p.
AVAILABLE FROM Population Reference Bureau, Inc., 777 14th St., N.W., Washington, DC 20005 ($2.00; two or more copies, $1.75 each).
PUB TYPE Statistical Data (110) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Agriculture; *Conservation (Environment); Developed Nations; Developing Nations; Energy; Energy Conservation; Fuels; *Geographic Distribution; Geography; Hunger; Instructional Materials; *Natural Resources; *Population Education; Secondary Education; *Social Studies; Soil Conservation; *Water Resources
IDENTIFIERS Third World

ABSTRACT

One of the challenges that face humanity is how to manage resource and environmental endowments in a way that will guarantee continued survival and ensure the well-being of future generations. Those resources most important to human survival are food, water, and energy. When the population of the world reached 5 billion in 1987, approximately 87 million people were being added to the world annually, and the world population is projected to reach 6.1 billion by 2000. The growing urban populations are consumers of food, energy, and raw materials rather than producers. Experts agree that enough food is produced to feed every one of the world's people, but food crises occur because cultivatable land, water resources, and wealth are not distributed proportionally to the population. Soil loss is greatest in Asia and Africa due to overgrazing, deforestation, inappropriate irrigation, and the use of incorrect farming methods. In order to feed the world's people, it is necessary to improve agricultural output with methods that do not harm the land. Rapidly growing populations and the expanding use of water make the careful use of the water supply essential. The continued use of oil as the major energy resource could strain developing countries' already struggling economies. In the past, the human species has been able to save itself from problems which were the result of its own creation. To do this now, all nations and interests must be represented in programs concerned with the management of the earth. (SM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

A POPULATION LEARNING SERIES

ED288796

Human Needs and Nature's Balance: Population, Resources, and the Environment

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

R. Worrall

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

PRB Population Reference Bureau, Inc.
777 14th St., NW, Washington, DC 20005
(202) 639-8040

SO018590

Human Needs and Nature's Balance: Population, Resources, and the Environment was written by Kimberly A. Crews. Special thanks to Neena Paul and Bud Thompson for research assistance and to Patricia Cancellier and PRB staff for editorial assistance.

Production Manager: Marjorie B. Dahlin
Production Assistant: Tracey A. Smith
Graphics: Joanna Lawrence

Copyright © 1987 by the Population Reference Bureau, Inc. Educators and students who wish to reproduce this booklet for use in their classrooms may do so without obtaining permission. Anyone who wishes to reproduce any part of this booklet in another publication must obtain written permission from the Population Reference Bureau, Inc., 777 14th Street, N.W., Washington, D.C. 20005.

Ordering Information: Additional copies of this module are available at the following prices: single copy, $2.00; two or more copies, $1.75 each. Include $1.00 for shipping/handling on orders under $20.00. A complete list of publications can be found on the back cover of this booklet.

October 1987

PRB

5041590

Human Needs and Nature's Balance: Population, Resources, and the Environment

Slow to make our initial appearance, we humans have quickly made our presence felt on the 4.5 billion-year-old planet Earth. The human capacity to shape and adapt our physical environment far exceeds that of other species, but like them, humans are dependent on the environment for survival and well-being. Human successes in utilizing the Earth's natural resources and molding the environment have increased both the length and quality of human life, making it possible for the human population to reach an unprecedented 5 billion people in 1987. But this success has not come without a price. One of the challenges that face humanity is how to manage our resource and environmental endowment in a way that will guarantee our continued survival and ensure the well-being of future generations.

Humans have such a remarkable capacity to control and manipulate the physical world for their own benefit (from the simple lighting of a fire to the creation of new genetic forms). We are also capable of destroying the environment and other species whose survival depends on it. Some of the effects of human activities—pollution, resource depletion, wildlife endangerment—are obvious. However, other effects are subtle and have a delayed, and sometimes unexpected, impact.

As we begin to assess human destruction of the environment, we also realize that there is much yet to be accomplished in order to improve the living standards for many in the human community. As world population continues its enormous expansion—most of which is concentrated in poor countries trying to raise their standards of living to levels comparable to those in the U.S. and other industrialized countries—the threat to the balance between population, resources, and the environment, and the need for careful management to counter that threat, have never been greater.

Jill Mestrick

Urban populations in Asia will nearly double between now and 2025.

In this reading, we study achievements in global food production, the use of water resources, and the harnessing of resources for energy. We then examine the environmental costs of these achievements and discuss the potential for managing the world's resources and environment to sustain future population growth. We begin with a review of trends in population growth and distribution, because population change is a basic determinant of resource use. The number of people on this earth, the way they live, and the regions they inhabit and exploit directly affect the global resource store and the state of the planet.

POPULATION
Global Trends

When the population of the world reached 5 billion in 1987, approximately 87 million people were being added to the world annually, more than ever before in history. This number will continue to increase and probably peak at about 90 million between 1995 and 2000. World population is projected to reach 6.1 billion by 2000. The number added each year has grown despite global reductions in birth rates. It will continue to grow because past high fertility rates have ensured that there will be a large number of people in the childbearing ages for the next decade or so. Even though these people will have fewer children than previous generations, they will collectively produce large numbers of children.

After 2000, the number of people added yearly to the world population will become progressively smaller un-

til the world population eventually stabilizes. The United Nations projects that the population will stabilize at about 10.2 billion in the last decade of the 21st century (see Figure 1).

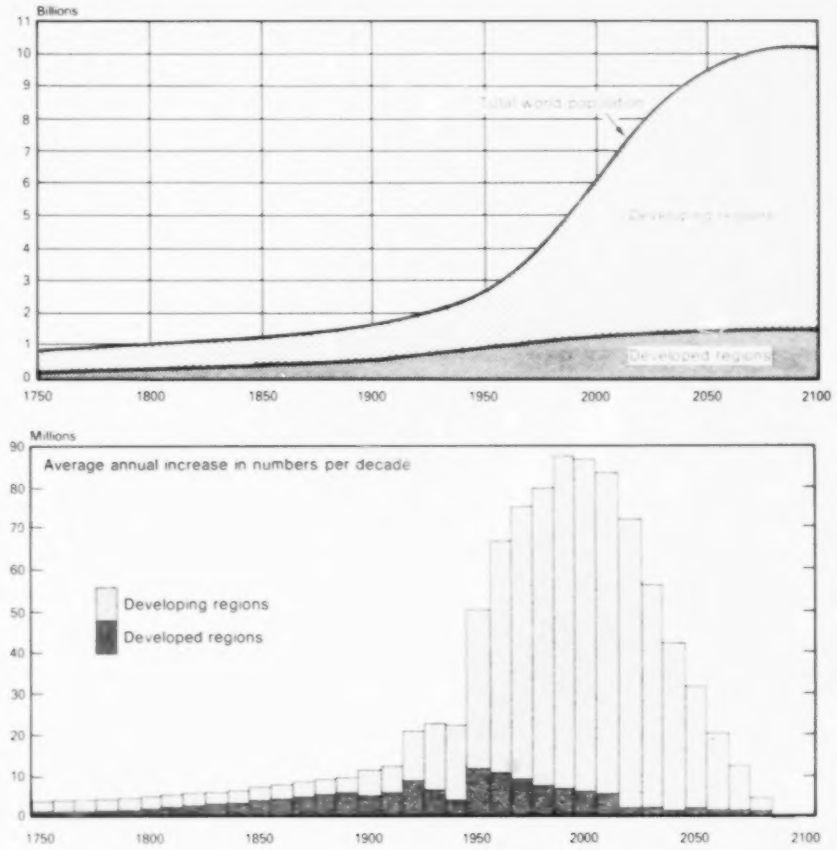
Nearly three-quarters of the world's 1987 population of 5 billion live in the less developed, low-income countries of Africa, Asia, and Latin America. Of the more than 3 billion people projected to be added to the world total between 1985 and 2025, over 90 percent will reside in these countries. Many of these countries already suffer food shortages; high infant mortality; massive rural to urban migration; inadequacies in health care, sanitation, water, housing, and education; high unemployment, particularly among youth; and high foreign debt. These countries, which are the least likely to have resources to adequately meet the needs of their populations, are faced with the possibility by 2025 of having to accommodate a population nearly twice today's size.

In many of these less developed countries, a large portion of the population is supported by subsistence farming. Rapid population growth in these countries leads to increased competition for fertile land areas and increased use of limited resources such as water and firewood. Many countries in Asia, Africa, and Latin America already face a loss of fertile land due to soil degradation, lack of access to water for farming and human consumption, and extreme shortages in wood used for fuel.

Urbanization and Consumption

When land available for farming declines, a growing number of people move to urban areas, further straining the limited resources there. While the urban poor are generally better off than the rural poor, many urban poor reside in environments that are less than ideal. Few governments in the developing world have adequate resources to provide their rapidly growing urban populations with housing facilities, schools, and transportation. Consequently, the urban poor often subsist in crowded, unsanitary shantytowns. According to the United Nations Children's Fund (UNICEF), 25 percent of urban dwellers in developing countries did not have access to safe drinking water in 1985.

Figure 1. World, Developing, and Developed Regions, Population Growth: 1750-2100



Source: Merrick, Thomas W., with PRB staff, "World Population in Transition," *Population Bulletin*, Vol. 41, No. 2 (April, 1986).

Urban areas throughout the world are growing, but nowhere are they growing as rapidly as in the less developed world. In 1987, 31 percent of persons in less developed countries resided in urban areas; by 2025 nearly 57 percent are expected to do so.[1] The proportion of people in Africa and Asia living in urban areas will nearly double during this period, while the percentage of Latin America's urban population will reach over 80 percent (see Figure 2).

The growing urban populations have an impact beyond the simple increase in numbers. Urban dwellers are consumers—rather than producers—of food, energy, and raw materials and will use these resources in greater quantities than their fewer rural neighbors.

The populations in the more industrialized countries, though smaller in number, have a far greater impact on the world's resources. While urban dwellers in the less developed countries consume more than their rural neighbors, the residents of developed countries on average consume much more than all people in less developed countries. North Americans consume in energy the equivalent of 45 "U.N. standard" barrels of oil per person per year, compared to 2 consumed by the average African.[2] North Americans also use more water. Average consumption in the U.S. is about 500 liters per person per day, compared to 25 in India. A person can survive on about 5 liters a day; approximately 80 liters are required to sustain a reasonable quality of life.[3] The average person requires a daily intake of 2,400 calories for well-being; developed-world citizens average about 3,300 calories per day,

while the average person in a less developed country consumes only 2,200 per day.

Considering the growing populations of the developing countries and the consumption patterns of the people of the more developed world, it is reasonable to question how the world's population will be sustained through the coming years. Will enough food be grown and distributed to those who need it? Will the land be sustained for continued agricultural use? Will water resources be sufficient for future generations? Will energy resources be affordable? Will future generations be able to survive in the environment carved out by their ancestors?

Inter-American Development Bank

The demand for milk and meat products has increased as incomes have risen worldwide.

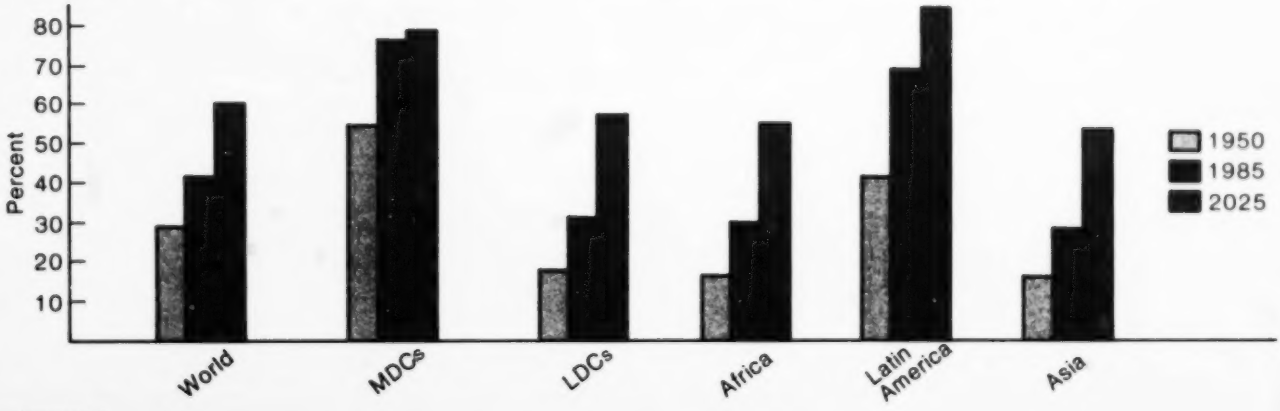
FOOD PRODUCTION
Global Trends

Recently, people all over the world responded to pleas for help on behalf of people starving in Africa. Ironically, more food is being produced per person now than ever before in human history and experts agree that enough food is produced to feed every one of the world's people. Crises occur because cultivable land, water resources, and wealth are not distributed proportionally to the population. Because of these disproportions, regional differences in food production are large. Some countries, such as the United States, continue to have large surpluses. Others, such as Ethiopia, where 86 percent of the population is supported by agriculture, must rely on imported food to feed their populations. While food supplies are apparently abundant, people go hungry because they cannot afford to purchase enough food and do not have the means to grow it.

World food production has kept pace with and even exceeded population growth. Between 1950 and 1985 worldwide cereal production grew at an average annual rate of 2.7 percent, outstripping population growth, which grew by an average of 1.9 percent during that period. Increases in food production in the past three decades can be attributed mainly to a rise in yields per acre and, to a lesser extent, to the expansion of the area under cultivation. While the total area used for agriculture has increased, the area available per person has declined as the population has increased.

The gains in productivity can be attributed to improvements in agricultural technology. New agricultural technologies served to increase food production substantially in North America and Europe during the 1950s. These technologies, which at first proved unsuccessful in the developing countries, met with some success in certain regions after extensive adaptation in the 1960s. New seed varieties designed to maximize yields, resist disease, and facilitate multiple cropping were developed; farmers were introduced to new chemical fertilizers, pesticides, and

Figure 2. World and Regional Urbanization Trends: 1950-2025



Source: ref. 1.

World Bank/Ray Witlin

"Green Revolution" agriculture has been successful in many parts of Asia.

herbicides; and the area under irrigation was increased. This period in the mid-1960s was termed "The Green Revolution," as methods such as these significantly improved crop yields in South America, Asia, and North Africa.

The "Green Revolution" was so successful in some regions, Asia in particular, that by 1983 the less developed world surpassed the more developed countries in cereal production for the first time. However, while significant achievements were made in some regions, particularly Asia, per capita food production declined in sub-Saharan Africa. Between 1961 and 1980, the average annual growth rate in production of food staples of 3.1 percent in the whole developing world (Asia, Latin America, the Middle East, and Africa) was higher than population growth (2.3 percent) for these regions; this was not true for sub-Saharan Africa, whose population grew at an average rate of 2.6 percent per year, compared to a 1.7 percent increase in food production. After experiencing gains in per capita food production in the late 1960s, Africa's per capita food production in 1985 fell below the 1960s level.

Environmental Impact

What are the environmental consequences of the gains in food production that have been achieved?

Industrial agriculture—capital- and input-intensive, using machinery, chemicals, and extensive irrigation—has in the short run increased the amount of food produced in North America, Europe, Australia, and New Zealand. Industrial agriculture techniques raise yields of fertile lands and allow farming of marginal lands. However, improper use of these techniques can be disastrous for the land by making it vulnerable to wind and water erosion (see Map 1). Some areas, farmable only with irrigation, have become unusable as a result of waterlogging and increased salinity of soils. In other areas where crops depend on irrigation, the cost of farming is a continued drain on virtually irreplaceable groundwater.

"Green Revolution" agriculture has had positive returns for farmers in select areas of the developing world. However, the rate of return in this type of farming is now diminishing. As the land left to be cultivated is marginal, farmers face the same problems as those in industrialized countries: loss of farmable land due to wind and water erosion and misguided irrigation practices.

Additional problems are caused by the extensive use of fertilizers and pesticides, which are essential to achieving high yields with the new seeds. The run-off of chemicals from fertilizers is causing increasing damage to water resources. The use of expensive pesticides, while enhancing productivity, contaminates soils and foods, threatens the health of humans, destroys pests' natural predators, harms non-pest species (including fish and birds), and encourages the development of pesticide-resistant pest species worldwide.

Another characteristic of "Green Revolution" agriculture is monoculture, or the constant growing of one crop. Monocultures are vulnerable to disease or pests. A single pest or disease can wipe out an entire crop. Monoculture also leads to a reduction of genetic diversity, diminishing prospects for improvement of plant varieties in the future.

At the other end of the agricultural spectrum, yet with its own set of environmental consequences, is traditional farming. This type of agriculture relies on uncertain rainfall rather than irrigation and is usually found in developing regions difficult to farm—drylands, highlands, and forests—with fragile soils. It is practiced in most regions of sub-Saharan Africa and more remote areas of Asia and Latin America by subsistence farmers, who are concerned with raising food for their families. They cannot afford the benefits of expensive fertilizers, pesticides, and high-yield seeds. Traditional farming on fragile soils can result in erosion. The clearing of the land to increase farming area contributes to deforestation, further erosion, and desertification. These practices, while increasing food supply in the short run, leave land less fertile and reduce the per capita production of food, placing future generations in jeopardy.

Food Prospects for the Future

Demand for food will increase as populations continue to grow and consumption patterns continue to change. Demand will be greatest in Africa, Asia, and Latin America, where populations are growing most rapidly. While enough food exists to feed today's population, government agricultural policies often discriminate against those who most need food—the rural poor—and do not provide enough incentives to maintain the quality of the land.

Past agricultural policies focusing on improving output have been successful; however, the success is diminishing in the 1980s. Farmers in industrialized countries have been supported by government subsidies, which encourage the production of large food surpluses. These surpluses

are often exported as food aid to developing countries. While these surpluses are welcomed by developing country governments, they harm the Third World farmer by depressing prices and reducing the incentive to improve domestic food production. This is a severe problem for countries whose economies are based on agriculture.

In the industrialized countries, subsidies often promote the overcropping of fertile land. The environmental results are disturbing. In the U.S., for example, the loss of topsoil due to overcropping has led to reduced productivity in many areas. This has led to the adoption of conservation measures which will reduce the amount of cropland area. The overuse of fertilizers and pesticides has led to the pollution of ground water supplies and lower productivity as the soil quality has declined. These outcomes suggest that the high levels of agricultural production may not be sustainable.

Considering the damage done to the agricultural base, the results of the following reports are even more disconcerting. A report by the International Food Policy Research Institute projects that between 1980 and 2000 food demand will be greater than food production in all developing regions except Asia. The situation for sub-Saharan Africa seems particularly bleak. A study carried out by the Food and Agricultural Organization (FAO) in 1984, based on information from 117 developing countries, concluded that by the year 2000, 64 countries—29 of them in Africa—would be unable to feed their projected populations from their own land resources if traditional methods of farming continued to be used. Twenty-eight nations would drop out of this group if they achieved a higher level of fertilizer and pesticide use, while another 17 could feed themselves if their agricultural methods were equivalent to those practiced in Western Europe; but 19 countries would remain unable to feed their populations even if methods similar to those used in Western Europe were practiced. World Bank data show that 26 of 92 low- and middle-income countries had lower daily calorie supplies per capita in 1985 than in 1965.[4]

While it is not necessary for each country to be able to grow enough food to feed its population, it is necessary to have other resources or products to trade for food if it can not be grown. In addition, in order to obtain global food security, or the assurance that all the world's future people can be fed, it is necessary to improve agricultural output with methods that can be continued without harming the environment. The key to achieving this goal is through government policies which 1) promote the establishment of a balance between cash crops and food crops; 2) encourage crop production and provide favorable returns for the small farmer in developing countries; 3) support practices which conserve resources and protect the environment; and 4) provide ample employment opportunities to eliminate poverty.

Map 1. Global Soil Erosion

The above map shows areas experiencing severe erosion. Soil loss is greatest in Asia and Africa. Erosion is caused by overgrazing, deforestation, inappropriate irrigation, and the misuse of other farming methods. Erosion makes soil less able to retain water, depletes it of nutrients, and reduces the depth available for the roots to take hold. As this process continues, land productivity declines. Eroded topsoil is carried to rivers, lakes, and reservoirs, silts up ports and waterways, reduces reservoir storage capacity, and increases the incidence and severity of floods.

Source: Ref. 3.

WATER

Global Trends

Theoretically, the world has more than enough fresh water to meet current and future human needs. However, rapidly growing populations and the expanding use of water for irrigation and industry, along with degradation of water sources, make the careful management of our water supply essential.

The challenge of providing water is already felt in many areas—particularly cities in developing countries experiencing rapid growth. A 1983 World Health Organization (WHO) survey representing approximately 80 percent of the developing world (China was excluded), showed that only about 71 percent of urban residents had access to a water supply and 59 percent had access to sanitation. The rural figures for water supply and sanitation are even less at 41 and 12 percent, respectively. Corresponding figures for the developed world approached 100 percent. Providing these services to rural and urban residents of the developing world is difficult, especially where demand exceeds local supply. Rapidly urbanizing areas provide a special challenge as long distance transport of water is often necessary and government resources are limited.

Most water resources, however, are not used for domestic purposes but for irrigation and industry. Agricultural irrigation accounts for 73 percent of worldwide water use, industry accounts for 21 percent, and public use accounts for just 6 percent. As the world continues to industrialize, per capita water use rises. In the more industrialized countries 40 percent of water is used for industry, compared with just 10 percent in the less industrialized areas.

Since 1950, the irrigated area of the world has nearly tripled,[5] and irrigated land contributes 20 to 30 per-

World Bank/Ray Witlin

New water pumps in Burkina Faso bring clean water to villages.

cent of the world's harvest.[6,7] The fact that irrigation accounts for 73 percent of global water use is even more important when one considers that only 50 to 75 percent of irrigated water is available for reuse, while about 90 percent of the water used in households and industry is recycled. Industrial water use in most developed countries has actually declined in the past decade as pollution control regulations have been enacted, forcing treatment and recycling. However, industrial water use in developing countries increases as industry expands; conservation and pollution control take a back seat to economic incentives.

Environmental Impact

The increase in water use for irrigation has depleted groundwater supplies in arid areas. Improper management of irrigation projects has lowered the productivity of some areas due to the ensuing salinization and waterlogging of agricultural land.

The increase in industrialization has led to an increase in water supplies polluted by municipal and industrial wastes. Surface water and groundwater reserves in both developed and developing countries have been affected. Inadequate disposal of nuclear, chemical, and other wastes, as well as fertilizer and pesticide residue from runoff, are to blame for polluted waters worldwide.

Most developed countries have taken steps to reduce municipal and industrial water pollution, although the levels of success vary widely. The percentage of population served by waste water plants in the countries of the Organization for Economic Cooperation and Development (OECD) ranges from less than 1 percent in Greece to 100 percent in Spain;[8] the average is about 55 percent. Measures taken to counter water pollution in the Eastern European countries and the Soviet Union are less established, and water supplies there are becoming increasingly polluted as industries expand.

Developing countries are seeing increasing levels of pollution in their surface and groundwater supplies due to expanding industry and rapid urbanization. Most of the pollution is attributable to pesticide and fertilizer residue and industrial wastes. However, rapid urbanization only exacerbates the problem as city wastes increase faster than the human population grows. The few measures that have been taken to control water pollution have been inadequate.

Future Water Resources

The demand for water will continue to increase as the world population grows and developing countries step up agricultural and industrial activities. However, because the distribution of global water resources does not correspond to the distribution of the global population, providing water in some regions may prove difficult. In many developing countries, rivers, lakes, creeks, and ponds serve both as sources of water for drinking and other domestic uses and for sanitation. Efforts to supply safe drinking water and sanitation facilities to these populations are proving a monumental task (see the box on the United Nations International Drinking Water Supply and Sanitation Decade). Developing country governments must not only provide these basic needs, but also deal with the problems of industrial and municipal pollutants in their waters.

And while governments struggle to supply basic drinking water, most of the water resources in these countries will be used to meet agricultural and industrial demands. Proper management of water use in these areas will be vital to sustaining water resources and human life. While efficient techniques for using industrial water and

INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE

In 1980 the United Nations proclaimed the period 1981-1990 as the International Drinking Water Supply and Sanitation Decade. The goal of the decade is to improve standards and levels of services in drinking water supply and sanitation to all people. The adverse effects of contaminated drinking water and poor sanitation contribute to water-borne diseases which cause the deaths of an estimated 15 million children under age five in developing countries each year, and also contribute to the ill health of the general population. Providing safe drinking water and adequate sanitation facilities are major stepping stones to the achievement of better health.

In order for the goal to be met, experts calculate that services would have to be improved for nearly 2.5 billion people worldwide, and the costs would exceed $30 billion per year. While the goal of providing these facilities to so many people is proving difficult to achieve, the achievements made to date are inspiring. The World Health Organization (WHO) surveys found that between 1980 and 1983 the water supply in most of the developing world increased only 10 percent and sanitation facilities improved by only 3 percent (see Table 1). However, the WHO monitoring system showed that, at the end of 1983, 59 countries had already developed Decade plans and an additional 31 countries had plans in preparation. So, while achievements in improving supplies may have been modest, the Decade has made important strides in creating awareness at national and international levels of the importance of safe water and sanitation for health.

efficient irrigation practices exist, they are practiced by only a few countries. In order to protect the global water supply, it will be necessary to expand the practice of conservation techniques.

In developed countries such as the United States, many experts believe that the only way to conserve water is to place a higher value upon it. Pricing controls on water, government regulation, and public education may be effective means of protecting water resources.

ENERGY

Global Trends

An important event within the realm of energy in the recent past is the disastrous explosion at the Soviet Union's Chernobyl nuclear power plant. This explosion resulted in the deaths of 31 people and forced the evacuation of an estimated 100,000 people from nearby towns for an undetermined period. The long-term health effects for exposed populations of the Soviet Union and Europe are as yet unknown.

This event is especially significant in light of nuclear power's increasing prominence. About 5 percent of the world's energy was supplied by nuclear power in 1986, while it supplied less than 1 percent before the first oil crisis in 1971. It had once been expected that nuclear energy would solve the world's energy problems. Although nuclear power supplies a significant portion of energy for the Soviet Union and Eastern Europe, it has not produced as much power as it was projected to a decade ago. Rising costs for constructing plants and safety concerns have slowed the number of plants being constructed. It is still too early to assess Chernobyl's long-range impact on the world's nuclear power industry.

In 1986 the world's consumption of major sources of commercial energy came to the equivalent of 7,589 million tons of oil. Oil provided the largest share, 38 percent, followed by coal (30 percent), natural gas (20 percent), and nuclear and hydropower (12 percent). By comparison, the total consumption of major energy sources in 1971 was equivalent to 5,555 million tons of oil. Thus, the total consumption of these energy sources increased by 37 percent within this period of time. The biggest shift in consumption of these sources was a decline in the percent of oil use and an increase in the consumption of nuclear energy (see Figure 3, p. 8).

The decline of oil's share of world primary energy use is extremely significant. In the early 1970s countries of the Organization of Petroleum Exporting Countries (OPEC), who produce a large share of world oil, successfully raised prices from about $3 to $13 per barrel. Although consumption of oil declined in response to the increase, prices remained constant until 1979. At that time the war between Iran and Iraq disrupted markets and, in 1982, allowed OPEC to more than double the price per barrel. Continued fluctuations in the oil market caused prices to drop to a low of about $11 per barrel in mid-1986, but by August 1987 the price had doubled once more.

In response to both price increases nations sought new sources of oil in the North Sea, Mexico, and Alaska. Developed countries have also been able to implement energy conservation strategies and develop alternative sources of energy. Because the conservation strategies have been effective and alternative energy sources are being used, oil's share of the energy market has declined.

Oil remains the main source of commercial energy used in the less developed countries (see Figure 4, p. 9). Increased industrial activities and urbanization demand an expansion of energy consumption, and the industries are dependent upon oil. The continued use of oil as their major energy resource, however, could strain developing countries' already struggling economies if they must spend more foreign exchange on oil imports. Unfortunately these countries also lack the resources to obtain other sources of energy, so demand for energy may remain unmet, and achievement of development goals may be hampered.

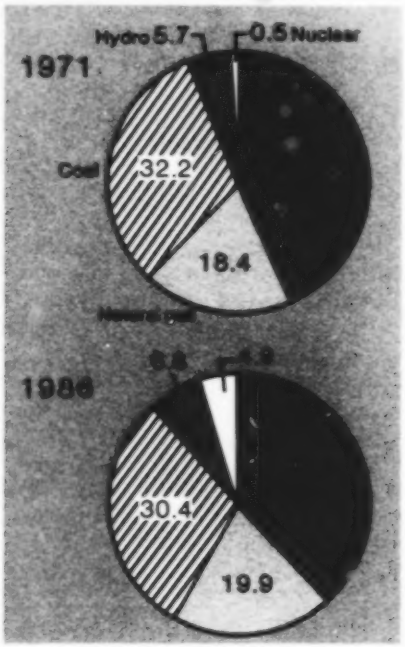
Table 1. Populations in Less Developed Regions with Access to Water Supply and Sanitation Services: 1980 and 1983 (Percentage)

Region	Water Supply		Sanitation	
	1980	1983	1980	1983
Africa				
Urban	66	57	54	55
Rural	22	29	20	18
Total	34	38	29	29
Asia and the Pacific*				
Urban	65	67	41	48
Rural	26	44	11	9
Total	37	51	29	21
Latin America & Caribbean				
Urban	78	85	56	80
Rural	42	49	20	20
Total	66	73	44	60
Western Asia				
Urban	94	95	80	93
Rural	41	50	18	25
Total	69	76	51	63
Global Trends				
Urban	70	71	49	59
Rural	27	41	14	12
Total	42	52	26	29

*Excluding China

Source: United Nations, General Assembly, Economic and Social Council, "Progress in the attainment of the goals of the International Drinking Water Supply and Sanitation Decade " (New York: March 1985).

Figure 3. World Commercial Energy Consumption: 1971-1986



Source: British Petroleum (BP), *BP Statistical Review of World Energy*, (London, 1987).

Environmental Considerations

The use of fossil fuels (oil, natural gas, and coal) may also need to be limited worldwide because of the negative effect they have on the environment. The burning of fossil fuels, which began with the Industrial Revolution in the 18th century, has caused a build-up of carbon dioxide in the atmosphere; if unchecked, the amount in 2060 could be double the 1980 level. As carbon dioxide retains outgoing heat, it causes the temperature of the earth's surface to rise. This phenomenon, known as the "Greenhouse Effect," threatens to make the earth warmer than at any other time in history. The warming of the planet could cause flooding as glaciers melt and disrupt rainfall patterns which, in turn, could change climatic conditions worldwide. These occurrences would have a costly impact on human settlements as well as agricultural production.

Air and water pollution, causing hazardous health conditions and damaging the land, are other environmental costs of fossil fuel use. In developed countries, the build-up of lead from vehicle exhaust has declined as measures were enacted to lower the amount of lead in automobile fuels. However, levels of lead in automobile gasoline in developing countries are still high, and air quality is poor and deteriorating.

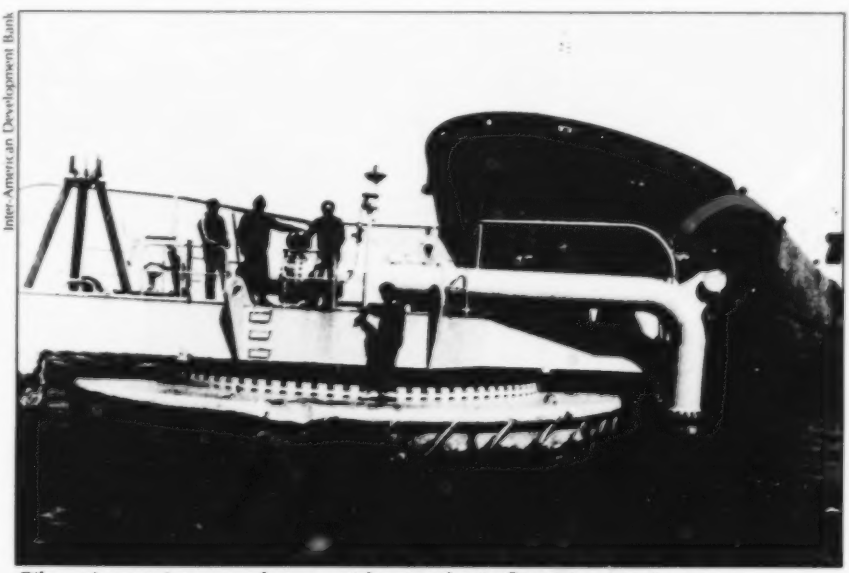
One of the most problematic forms of air pollution is acid rain, which comes mainly from the release of sulfur oxides and nitrogen oxides into the atmosphere. These pollutants are partially generated from the use of coal and oil in industries as well as automobile emissions. Acid rain is particularly damaging to forests, lakes, and streams. The damage has been most severe in the eastern parts of Canada, the U.S., and Central Europe; other areas—the Soviet Union, Australia, and Brazil—have also reported extensive damage.

As the environmental damage caused by the use of fossil fuels becomes more varied and more prevalent, the need for wider adoption of environmental safety measures and the use of alternate sources of energy is even more apparent. However, there are risks associated with the use of all types of energy sources. The incident at the Chernobyl power plant has focused more attention on the possibility of large-scale disasters and other environmental dangers resulting from nuclear power use. The use of hydropower, wood, and other renewable resources also has its costs. The careful management of existing and potential energy resources can reduce the risks involved in their use and ensure an adequate supply of energy for the future.

Future Energy Resources

Despite their environmental costs, fossil fuels still provide more than 75 percent of the world's commercial energy. While oil is still the world's largest energy source, its use is declining and supplies are growing more expensive to extract. Coal is plentiful and its use is growing, but its environmental costs are high. The use of natural gas is also increasing, but it is expensive to exploit and therefore is used only in selected areas. The fossil fuel resources that do remain are not distributed equitably, either geographically or according to population concentrations. The developed world, which houses only a quarter of the world's population, produces and holds in reserve more than 60 percent of these fossil fuels.

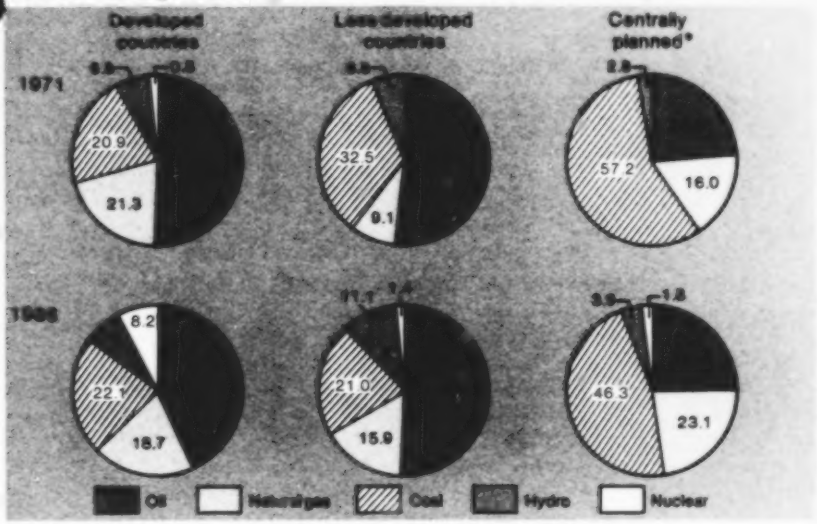
The developed countries have already been forced to alter their energy consumption patterns and will continue to do so as fossil fuel sources become more costly. Conservation efforts have been successful and must be continued in order to make the most efficient use of the energy sources now available. The development of nuclear energy has taken some of the burden off demand for fossil fuel sources, but has not sup-



Inter-American Development Bank

Oil remains a main source of commercial energy despite fluctuations in prices.

Figure 4. Regional Commercial Energy Consumption: 1971-1986



*Centrally planned countries include: Albania, Bulgaria, China, Cuba, Czechoslovakia, East Germany, Hungary, Kampuchea, Laos, Mongolia, N. Korea, Poland, Romania, USSR, Vietnam, and Yugoslavia.

Source: British Petroleum

plied as much energy as was originally expected. The further development of renewable energy resources such as wind, solar, geothermal, and hydropower can help meet the demand for energy without the environmental risks associated with fossil fuel use.

The demand for energy resources in developing countries will rise with their growing populations, rising incomes, and increased industrialization. Apart from the Middle East, which holds more than 50 percent of all oil reserves, developing countries have few other fossil fuel holdings, yet depend upon them for approximately 85 percent of their commercial energy needs. With the price of oil dependent on political decisions and its availability limited, purchase of oil may be less economically feasible in the future.

The future for many developing countries may lie in the conservation of the traditional energy resource—wood—and the further use of other renewable energy sources—hydropower, wind power, solar power, and biomass. The overuse of wood in many countries is causing serious environmental stress (see box on fuelwood). The technology needed to make use of nontraditional sources is expensive, as well as dependent on the natural geologic and climatic conditions of the region. Obtaining adequate energy resources will be one of the major challenges for many developing countries in future years.

AN UNCERTAIN FUTURE?

The future of the world in which we live is uncertain. We can project the number of humans that will live on this earth and the areas which they will inhabit based on past and present trends in population growth. We know approximately how much food is produced, the volume of water used and how it is used, and approximately how much and what kind of energy sources are tapped for human consumption. We know that population growth is related to the demand for food, water, and energy resources and also to the problems of limited supplies, pollution, and land degradation associated with the production of food and the use of water and energy resources. While we know that damage to the environment is extensive, the degree of the damage as well as the implications for the future are uncertain.

In the past the human species has been able to save itself from problems which were the result of its own creation. As technologies have allowed man to lower the rate of death, additional technologies have been introduced which allow the controlling of births. As the use of coal became more costly, in both monetary and environmental terms, technology was developed to exploit oil as an energy resource. As water resources in some regions have become scarce, more ef-

FUELWOOD

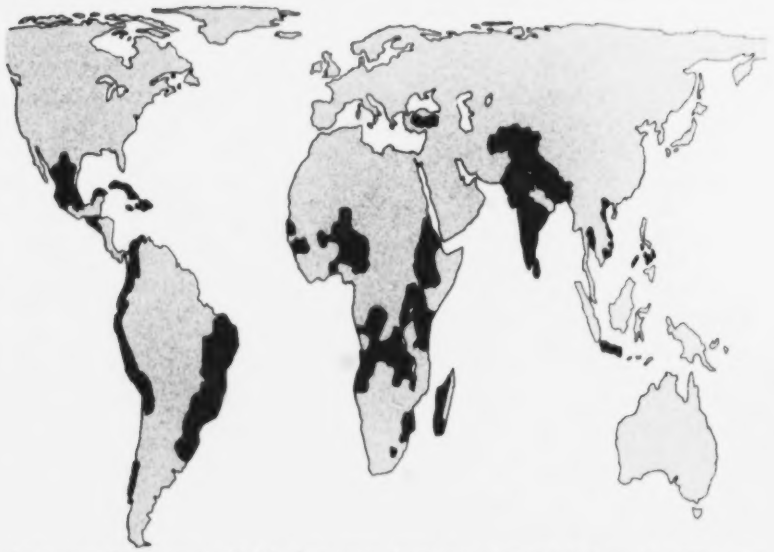
Determining the actual volume of fuelwood use is difficult. Most of the wood consumed is not for commercial purposes and data are nonexistent or extremely limited. Yet wood, crop residue, and dung provide close to half of the energy used in the developing world. In rural areas they provide more than 90 percent of energy used in the home for cooking and providing heat.

People in developing countries are so dependent on wood as a source of energy that in many regions trees are being cut down faster than they can be replaced. Livestock grazing further contributes to the scarcity of trees. This has become a serious problem, not only because of the resulting fuelwood scarcity, but also because of further damage to the environment; overcutting of forests leads to erosion, which can in turn lead to desertification (see Map 2, p. 10).

As populations grow, the need for resources grows, and the situation becomes more dangerous as destruction increases. The future of the land and the survival of future generations are put in jeopardy as overcutting of trees continues. As fuelwood becomes more scarce it takes more time and energy to collect, so the prices rise, cutting into purchasers' budgets. Scarcity also leads to conservation, which in turn may lead to more uncooked meals, possibly fewer meals, and therefore malnutrition.

When wood becomes scarce, people begin to use alternate sources of energy such as dung and plant residue. This creates additional environmental problems because these sources provide the soil with nutrients and their use as energy resources thus deprives the soil of these needed nutrients. The depletion of soil nutrients could affect crop yields in areas where commercial fertilizers are too expensive to use.

Map 2. Global Fuelwood Shortages



The above map shows areas which had an acute shortage or deficit of fuelwood in 1980. Deficits are worst in the arid and semi-arid regions of Africa, South Asia, and mountainous regions of Latin America. Overcutting and the removal of trees lead to soil erosion and desertification.

Source: Kendall, Sarita, "Fuelwood: the lessons of failure," *Earthwatch*, Number 20 (1985).

ficient techniques of irrigation or industrial use have been discovered and implemented. And so on.

Past problems have been solved relatively easily. People and governments have taken a casual attitude toward the destruction of the environment, confident that a solution will be found. And most assessments of the global environment confirm that there are cures, but the restoration process is costly and involves global cooperation. It will also be a difficult challenge to realize the interrelationships between population growth, resource use, and political actions including economic, military, and development.

The key to providing a world that future generations will be proud to inhabit is the careful management of resources and the environment. Because all nations and interests have a stake in protecting the environment, all nations and interests must be represented in programs concerned with the management of the earth.

Global Cooperation

In December 1983 an important step was taken towards the goal of protecting the global environment. The General Assembly of the United Nations called upon the World Commission on Environment and Development to formulate "a global agenda for change":

- "to propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond;
- to recommend ways concern for the environment may be translated into greater co-operation among developing countries and between countries at different stages of economic and social development and lead to the achievement of common and mutually supportive objectives that take account of the interrelationships between people, resources, environment, and development;
- to consider ways and means by which the international community can deal more effectively with environmental concerns; and
- to help define shared perceptions of long-term environmental issues and the appropriate efforts needed to deal successfully with the problems of protecting and enhancing the environment, a long-term agenda for action during the coming decades, and aspirational goals for the world community."[9]

The meetings of this Commission resulted in the preparation of the Brundtland report, released in April 1987 as *Our Common Future*. This report is significant because the organizers recognized the importance of the participation of many nations and interests in the achievement of these goals. The report was assembled by commissioners from 21 countries representing a wide range of political philosophies and expertise, including finance and planning, agriculture, science, technology, and environment. The analysis, broad remedies, and recommendations for a sustainable course of development, which were the result of over three years of public hearings and debate, met with the unanimous approval of all commissioners. The fact that these government officials were able to agree upon recommendations for a variety of issues—including population, food production, energy, and industry—is a step in the right direction for the achievement of global cooperation in the development of a sustainable society.

References

1. United Nations Population Division, *The Prospects of World Urbanization, Revised as of 1984-1985* (New York, 1987).
2. World Resources Institute and The International Institute for Environment and Development, *World Resources 1986* (New York: Basic Books, 1986).
3. Myers, Norman (ed.), *GAIA: An Atlas of Planet Management* (New York: Anchor Press, Doubleday & Company Inc., 1984).
4. World Bank, *World Bank Development Report 1987* (New York: Oxford University Press, 1987).
5. Worldwatch, *State of the World 1986* (New York: Norton, 1986).
6. Myers, *GAIA: An Atlas of Planet Management*.
7. World Resources Institute and The International Institute for Environment and Development, *World Resources 1987* (New York: Basic Books, 1987).
8. WRI and IIED, *World Resources 1987*.
9. World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987).

Other Sources Consulted

Food and Agriculture Organization (FAO), *Land, Food, and People* (Rome: 1984).

Paulino, Leonardo A., *Food in the Third World: Past Trends and Projections to 2000*, Research Report 52, International Food Policy Research Institute (Washington: June, 1986).

Worldwatch, *State of the World 1987* (New York: Norton, 1987).

Human Needs and Nature's Balance: A Review

Part A. Short Answer

1. United Nations projections show that world population is expected to grow until it reaches ____ billion people at the end of the 21st century.

2. Asia, Africa, and Latin America will house ____ percent of the people projected to be added to the world population between 1985 and 2025.

3. By 2025 ____ percent of people in less developed countries will live in urban areas; in 1987____ percent lived in cities.

4. **True or False**. Enough food is currently being produced to feed the world's population.

5. List at least six negative effects of industrial and "Green Revolution" agriculture.

_____ _____

_____ _____

_____ _____

_____ _____

6. List at least three negative effects of traditional (or subsistence) agriculture.

_____ _____

_____ _____

7a. How can foreign food aid hurt farmers in less developed countries? _____

_____

_____

_____

7b. What other kinds of foreign aid do you think could help less developed countries? _____

_____

_____

8. The majority of water is used for _____ (irrigation, industry, or domestic) purposes.

9. Describe the achievements of the UN International Drinking Water Supply and Sanitation Decade. _____

_____

_____

_____

10. Fossil fuels are the primary sources of commercial energy for the world, but their use leads to serious environmental problems. List at least three of these problems.

_____ _____

_____ _____

11. What are the main sources of energy used in the less developed countries? _____

_____

12. What are some important considerations to keep in mind when developing strategies or plans to ensure a sustainable environment?

_____

_____

_____

_____

Part B. Data Analysis

1. Examine Figure 1. What proportion of the world's population is projected to live in less developed regions in 2100? In more developed regions? How does this compare with the distribution in 1950 and the projected distribution in 2000?

2. Study Figure 2. Which region (Africa, Asia, or Latin America) experienced the greatest change in the proportion of urban population between 1950 and 1985?

3. Why is the percentage of urban population in the less developed regions as a whole so much less than the percentage in Latin America?

4. Examine Map 1. What types of agriculture (i.e. industrial, "Green Revolution," or traditional) are likely to have contributed to erosion in different regions?

5. Refer to Table 1. Which area has the least adequate access to a water supply? The highest? Which area has the least access to sanitation services? The highest?

6. Study Figure 4. Using the percentages given for different energy sources, project the energy use of all three regions for the 15-year period 1986 to 2000 (approximations adequate). Do you think these projections are realistic? What events might occur that would have an impact on these projections?

Glossary

Biomass. Plant and animal matter that can be used in any form as a source of energy.
Birth Rate (or Crude Birth Rate). The annual number of births per 1,000 population. Not to be confused with the "growth rate" or "fertility rate."
Childbearing Ages. The reproductive age span of women, arbitrarily assumed for statistical purposes to be 15-44 years in the U.S. In other countries, the range is often set at 15-49 years.
Deforestation. The loss of trees, due to overcutting of forests. One consequence of deforestation is soil erosion, which results in the loss of protective soil cover and the water-holding capacity of the soil.
Desertification. The process of grasslands being converted to desert mainly as a result of deforestation, overgrazing, and erosion due to poor land management.
Developed Countries (Industrialized Countries). Those countries which have higher levels of per capita income, industrialization, and modernization. The "more developed" regions of the world, according to the United Nations, include Europe, North America (Canada and the United States), Japan, Australia, New Zealand and the USSR.
Developing Countries. Those countries which have lower levels of per capita income, industrialization, and modernization. Also called less developed country or Third World countries.
Fertility Rate. The actual reproductive performance of an individual, a couple, a group, or a population.
Genetic Diversity. A wide variety of many plant species.
Greenhouse Effect. A warming of the atmospheric temperature, resulting from solar radiation (light) coming in but outgoing heat radiation being absorbed. Carbon dioxide in the atmosphere is a potent absorber of heat radiation. Therefore increasing the carbon dioxide content of the atmosphere may increase global temperatures, causing climatic change.
Multiple Cropping. The harvesting of two or more crops from the same field in one year.
Population Projection. Computation of future changes in population numbers, given certain assumptions about future trends in the rates of fertility, mortality, and migration. Demographers often issue low, medium, and high projections for the same population, based on different assumptions about how these rates will change in the future.
Population Stabilization. An unchanging rate of growth and an unchanging age composition in a population, because age-specific birth and death rates have remained constant over a sufficiently long period of time.
Marginal Land. Land which is less fertile and will therefore have lower crop yields than more fertile soil unless input-intensive methods are used.
Salinization. The accumulation of salts in the soil to the point where plants cannot grow. This process is caused by irrigation as salts brought with the water remain in the soil as the water evaporates.
Sub-Saharan Africa. The countries on the African continent south of the Sahara Desert.
Subsistence Agriculture. Farming at a level at which only enough food is produced to meet immediate local needs.
Urbanization. Growth in the proportion of a population living in urban areas.

For Further Reading and Research

From the Population Reference Bureau

The 1987 World Population Data Sheet, by Carl Haub and Mary Mederios Kent. 1987, Population Reference Bureau, 777 14th St. NW, Washington, D.C. 20005. Wall Chart, $2.00 plus $1.00 shipping/handling.

Fifteen columns of population, development, and resource data for the world, its major regions, and 176 countries.

Global Population Trends: Challenges Facing World Leaders, by Paola Scommegna. *Population Learning Series*, 1986, Population Reference Bureau (address above). 12 pp. $2.00 plus $1.00 shipping/handling.

An overview of world population trends and policy issues which describes the impact of population growth in less developed regions and the impact of slow growth in more developed regions. It also includes a glossary and suggested resources for further research.

Population Handbook, by Arthur Haupt and Thomas T. Kane. 1985, Population Reference Bureau (address above). 70 pp. $5.00 plus $1.00 shipping/handling.

A guide to basic demographic terminology. Definitions are clarified with examples.

Population in Perspective: Regional Views, by PRB staff. *Population Learning Series*, 1986, Population Reference Bureau (address above). 42 pp. $2.00 plus $1.00 shipping/handling.

Essays on the seven regions of the world to acquaint you with the population issues relevant to each region. The seven regions covered include North America, Latin America and the Caribbean, the Soviet Union and Eastern Europe, the Middle East and North Africa, sub-Saharan Africa, and Asia and the Pacific.

Population, Resources, Environment: An Uncertain Future, by Robert Repetto. *Population Bulletin*, Vol. 42, No. 2 (July 1987), Population Reference Bureau (address above). 44 pp. $4.00 plus $1.00 shipping/handling.

This *Bulletin* provides new data and emphasis on the role of sound management and government responsibility in achieving a balance between population, resources, and the environment.

World Population in Transition, by Thomas W. Merrick. *Population Bulletin*, Vol. 41, No. 2 (April 1986), Population Reference Bureau (address above). 51 pp. $4.00 plus $1.00 shipping/handling.

A synopsis of world population issues including an historical overview and current trends. This *Bulletin* includes discussion of the important debate about whether rapid population growth deters or stimulates economic growth.

Other Resources

Environment 87/88, by John Allen, ed. The Dushkin Publishing Group, Inc., Sluice Dock, Guilford, Connecticut 06437. 1987, 241 pp. $9.50.

This year's annual edition of **Environment** provides a wide range of articles on environmental issues culled from major newspapers, journals, and periodicals. In addition to the annotated table of contents and index, there is a topic guide which lists issues alphabetically, allowing researchers to locate related topics. A glossary and a select list of environmental agencies and magazines are also provided. The five units that comprise this book focus on population, energy, pollution, resources (land, water and air), and the biosphere. Each unit is prefaced by an overview.

The Environmental Crisis: Opposing Viewpoints, by Julie S. Bach and Lynn Hall, eds. Opposing Viewpoints Series, Greenhaven Press, 577 Shoreview Park Rd., St. Paul, Minnesota 55126. 1986, 263 pp. $6.95.

This book, which presents balanced, opposing points of view on complex issues, is a useful tool for those wishing to become informed on a variety of environmental topics. Opposing viewpoints are paired, each viewpoint being preceded by a short quotation that is representative of its message. The book is interspersed with exercises designed to develop skills for evaluating information, critical thinking, empathizing, etc. No particular viewpoint is advocated here; rather the reader is encouraged fully to develop his/her own point of view by understanding the views of others. Teachers may find this a helpful tool in organizing class discussions. A bibliography of books and periodicals and a list of organizations concerned with the issues debated are also provided.

Environmental Refugees, by Essam El-Hinnawi. United Nations Environment Program, P.O. Box 30552, Nairobi, Kenya. 1985, 41 pp.

Refugees are not always displaced by war and political tension; this book is about people who have been displaced by environmental crises and disasters. It describes the kind of people who are most affected by natural disasters, how and why people damage the land that supports them, the problems in relocating populations, and the effects of war on the environment. A discussion of environmental accidents and their possible prevention is also included.

GAIA: An Atlas of Planet Management, ed. by Dr. Norman Myers. Anchor Press, Doubleday & Company Inc., Garden City, New York. 1984, 272 pp. $17.95.

An assessment of humankind's place on the planet Earth, the damage humans have done to the environment, and the steps that can be taken to remedy this damage. Introductions by experts, innovative charts and maps, and colorful design make this atlas an exciting resource.

State of the Ark: An Atlas of Conservation in Action, by Lee Durrell. Gaia Books Ltd., Doubleday & Company Inc., Garden City, New York. 1986, 224 pp. $14.95.

A wealth of information on the earth and the multitude of organisms that inhabit it. Four of the book's five chapters document the state of the earth, its natural ecosystems, species of plants and animals, and its main regions. The final chapter discusses the origins and accomplishments of conservation movements worldwide. It concludes with suggestions for corrective action that will assure the future growth of humankind. Color photographs, drawings, charts, and graphs make this book attractive and easy to read.

Taking Sides: Clashing Views on Controversial Environmental Issues, 2nd ed., by Theodore D. Goldfarb, ed. The Dushkin Publishing Group, Inc., Sluice Dock, Guilford, Connecticut 06437. 1987, 323 pp. $9.50.

Taking Sides is a collection of opposing viewpoints on a number of environmental issues. Students develop critical thinking skills as they are introduced to contradictory viewpoints on issues such as acid rain, hazardous wastes, population control, and the use of pesticides.

PRB Classroom Materials

Population Learning Series

Each 13- to 18-page booklet contains a reading, additional resources, and exercises. $2.00 each, including issue of *Interchange* with teacher's guide ($1.75 each on orders of two copies or more).

Human Needs and Nature's Balance: Population, Resources, and the Environment, October 1987
Global Population Trends: Challenges Facing World Leaders, February 1987
Population in Perspective: Regional Views, October 1986
Women in the World, April 1986
World Population: Toward the Next Century, May 1985
World Population: Fundamentals of Growth, December 1984
The American Family: Changes and Challenges, October 1984
Food and Population: A Global Concern, December 1983
The Environment to Come: A Global Summary, March 1983
Immigration: Questions and Answers, July 1982
How America Studies Itself: The U.S. Census, February 1980

Teaching Kits

An Introduction to Population Dynamics, $17.50
The World's Women Teaching Kit, $7.50
Population Perspective: A Guide to World Population Issues for Model UN Participants, $5.00

Chart Series

World Population: Fundamentals of Growth wall charts; set of six, $12.50 per set.

Membership in PRB

Special discount membership rates are in effect for students and educators: $20 per year for students and $28 per year for educators. Membership entitles you to receive 4 issues of the *Population Education Interchange* newsletter, 2 issues of the *Population Learning Series*, 4 *Population Bulletins*, 11 issues of *Population Today*, occasional issues of *Population Trends and Public Policy*, and the *U.S.* and *World Population Data Sheets*. (Proof of student or teacher/professional status is required, such as a photocopy of a valid student I.D. or a copy of your school's letterhead. A regular membership fee is $40 per year.)

PRB Population Reference Bureau, Inc.
777 14th St., NW, Washington, DC 20005
(202) 639-8040

Please send me the materials listed at the right. I enclose $ _____.

_____
Name
_____
Address
_____
City
_____
State Zip

☐ Membership dues enclosed ($20 student or $28 educator membership)

Item	Quantity	Price
Shipping/handling fee		$1.00